Claims 39 and 41-47 stand rejected under 35 U.S.C. § 103 as being unpatentable over Azuma et al. (U.S. Patent No. 5,516,363) ("Azuma"). In particular, the Advisory Action dated February 4, 2002 states that "Azuma clearly states that having a dielectric film of uniform stoichiometry will produce film of minimum crystal defects. Therefore, as stated in the previous action, it would have been obvious to have a dielectric film in a semiconductor device be doped with additional elements in order to have a uniform stoichiometry through the film's entire structure." Reconsideration is respectfully requested.

Claim 39 recites, inter alia, a capacitor comprising "a material layer having a first level and a second level, said first and second levels being connected by a sidewall region between said first and second level, and a doped BST high dielectric constant thin film material deposited on at least one said sidewall region, said deposited BST thin film material having a post deposition doping such that the stoichiometry of said BST high dielectric thin film material is substantially uniform at least at said sidewall region."

The present invention is directed to ensuring a uniform stoichiometry in BST high dielectric thin film material when the material is applied to a sidewall, or to form a sidewall. The film structure's stoichiometry is critical to the electrical functionality of the film. Therefore, a uniform stoichiometry is necessary to ensure that this the film has good dielectric properties. Applying a thin film dielectric material to form a sidewall, or over a sidewall, formed by a mesa, step, cap, or another three dimensional structure, usually effects the stoichiometry of the thin film dielectric layer. Regardless of doping that may occur before deposition, the resulting thin film layer will have an inhomogeneous stoichiometry. For example, if a film of Titanium is desired, the deposition at the sidewall of a step structure will produce a decreased percentage of Titanium. The present application addresses and solves this issue by ensuring that the BST thin film dielectric applied either over, or to form, a sidewall has a uniform stoichiometry to maintain the good dielectric properties. This is accomplished by the doping of the BST material subsequent to the BST being deposited to produce a substantially uniform stoichiometry at least at a sidewall

region. (See Spec. at least at page 4, lines 18-21, "The present invention overcomes these problems by implanting TI ions by ion implantation after MOCVD process of BST. With this technique, it is possible to tailor the Ti composition in BST films, preferably on the sidewalls, by appropriate ion implantation angles.")

All claims have been amended to clearly define a thin film which is formed by doping during deposition and then further doping after deposition to produce a substantially uniform stoichiometry in the final film at least at a sidewall thereof. Such a double doped film is neither shown nor suggested by the cited reference.

Azuma discloses a method for producing specially doped dielectric compositions having high dielectric constants and low conductive leakage currents. Azuma discloses a method to achieve a uniform stoichiometry in dielectric materials by adding doping, and possibly adding a dopant compensator, to the formulation of the precursor material. Although Azuma may suggest that additional doping or dopant compensator (B or A site material) may be required in the formulation of the precursor material to maintain a uniform stoichiometry in the precursor during, Azuma does not disclose or suggest that the application of a thin film dielectric layer over a sidewall, or to form a sidewall, will effect the uniform stoichiometry of the resulting thin film dielectric material layer. According to Azuma, the precursor dielectric material is applied to the substrate after adding the additional doping. Therefore, the precursor material is applied **after** attempting to homogenize the material's stoichiometry and **before** the stoichiometry will be effected by applying the material over a sidewall or to form a sidewall.

Furthermore, Azuma's application method is directed toward two dimensional surfaces as the application discloses a "spin on" method to apply the precursor material to form a thin film dielectric layer. As seen in Azuma FIG. 3, Azuma suggests the application of dielectric materials to horizontal surfaces. Azuma does not suggest application of the precursor thin film dielectric material to sidewalls or to form sidewalls. Nor does Azuma suggest or disclose the problem of maintaining the stoichiometry of thin film dielectric material when applied to a sidewall formed from mesas, steps, trenches, or other three

dimensional structures. Furthermore, Azuma does not disclose or suggest any particular techniques to apply the thin film dielectric material to a sidewall associated with a mesa, stack, trench or other three dimensional structure on the substrate that will maintain the uniform stoichiometry of the thin film dielectric material on the sidewall. Therefore, the precursor may have a uniform stoichiometry when formulated, but after applying the precursor to sidewalls, the thin film dielectric layer may no longer have a uniform stoichiometry.

Only the present application identifies and addresses the problem of maintaining a substantially uniform stoichiometry of the thin film dielectric material layer film after its deposition on a side wall formed by a mesa, stack, trench, or other three dimensional structure. Since the Azuma reference does not identify or recognize the problem, which is recognized and solved by the claimed invention, there is no motivation, teaching or suggestion in the reference for the claimed invention. If the prior art does not even recognize the problem, the solution to the problem can not be deemed obvious. See, In re Sponnoble, 405 F.2d 578, 160 U.S.P.Q. 237 (C.C.P.A. 1969); Ex parte Campbell, 211 U.S.P.Q. 575 (Bd. App. 1981). Azuma does not identify or recognize the problem addressed by the invention, much less disclose or suggest its solution.

Additionally, the Advisory Action dated February 4, 2002, objects to allowance referring only to Azuma. But, as argued and referred to in the Request for Reconsideration filed January 10, 2002, Laibowitz (U.S. Patent No. 6,088,216) also does not disclose "doping of said BST high dielectric thin film material being such that the stoichiometry of said BST high dielectric film material is substantially uniform at least at said side wall region." (reciting Office Action, October 10, 2001, page 2, ¶ 2). Since neither Laibowitz nor Azuma recognize or solve the problem addressed by the present invention, they do not render the claimed invention obvious. Accordingly, the rejection of claim 39 should be withdrawn.

Claims 41-47 depend from claim 39 and likewise contain the requirement that the stoichiometry of the BST high dielectric film material is doubled doped to produce a

substantially uniform stoichiometry at least at the sidewall regions. Accordingly, the rejection of those claims should be withdrawn.

Claims 48 and 50-56 stand rejected under 35 U.S.C. § 103 as being unpatentable over Azuma as applied to claims 39, and 41-47, as above. In particular, the Advisory Action states that "Azuma clearly states that having a dielectric film of uniform stoichiometry will produce film of minimum crystal defects. Therefore, as stated in the previous action, it would have been obvious to have a dielectric film in a semiconductor device be doped with additional elements in order to have a uniform stoichiometry through the film's entire structure." Reconsideration is respectfully requested.

Claim 48 recites, inter alia, a capacitor comprising "a material layer having a first level and a second level, said first and second levels being connected by a sidewall region between said first and second levels, a doped BST high dielectric constant thin film material deposited on at least one said sidewall region, said deposited BST thin film material having a post deposition doping such that the stoichiometry of said BST high dielectric thin film material is substantially uniform at least at said sidewall region, and a capping layer provided over at least a portion of said BST thin film material."

As argued above and in the Request for Reconsideration filed January 20, 2002, Azuma discloses a method to attempt forming a uniform stoichiometry of a precursor dielectric material prior to its being deposited. Azuma does not recognize the loss of uniform stoichiometry in thin film dielectric material that occurs on sidewalls after deposition. Furthermore, Azuma does not disclose or suggest doping the thin film material after deposition to achieve substantially uniform stoichiometry.

Additionally, the Advisory Action dated February 4, 2002 objects to allowance referring only to Azuma. But, as argued in the Request for Reconsideration filed January, 10, 2002, Leung (U.S. Patent No. 5,563,762) discloses a capping layer, it also does not disclose or suggest doping the thin film dielectric material after deposition on a sidewall to achieve a substantially uniform stoichiometry. Since neither Azuma nor Leung nor

Laibowitz recognize or solve the problem recognized and solved by the present invention, they do not render the claimed invention obvious. Accordingly, the rejection of claim 48 should be withdrawn.

Claims 50-56 depend from claim 48 and likewise contain the requirement that the stoichiometry of the BST high dielectric film material be double doped to produce a substantially uniform stoichiometry at least at the sidewall regions. Accordingly, the rejection of those claims should be withdrawn.

Claims 74-83 stand rejected under 35 U.S.C. § 103 as being unpatentable over Azuma. In particular, the Advisory Action states that "Azuma clearly states that having a dielectric film of uniform stoichiometry will produce film of minimum crystal defects. Therefore, as stated in the previous action, it would have been obvious to have a dielectric film in a semiconductor device be doped with additional elements in order to have a uniform stoichiometry through the film's entire structure." Reconsideration is respectfully requested.

Claim 74 recites, inter alia, an integrated circuit capacitor device comprising: "a material layer having a first level and a second level, wherein said first and second levels are connected by a sidewall region between said first and second levels, a first electrode provided at least on said sidewall region, a doped BST high dielectric constant thin film material provided on at least one said first electrode, said deposited BST high dielectric thin film material having a post deposition doping such that the stoichiometry of said BST high dielectric thin film material is substantially uniform at least at said sidewall region, and a second electrode provided on said BST high dielectric thin film layer."

As argued above and in the Request for Reconsideration filed January 20, 2002, Azuma discloses a method to attempt forming a uniform stoichiometry of a precursor dielectric material prior to its being deposited. Azuma does not recognize the loss of uniform stoichiometry in thin film dielectric material that occurs on sidewalls after deposition. Furthermore, Azuma does not disclose or suggest doping the thin film material

after deposition to achieve substantially uniform stoichiometry.

Additionally, the Advisory Action dated February 4, 2002 objects to allowance referring only to Azuma. But, as argued in the Request for Reconsideration filed January 10, 2002, Hosotani (U.S. Patent No. 6,051,859) discloses a stacked type capacitor semiconductor device formed on the contact hole of the underlying insulating film, and method for manufacturing the device. Hosotani also does not disclose or suggest doping the thin film dielectric material after deposition on a sidewall to achieve a substantially uniform stoichiometry. As the Office Action points out, "Hosotani does not disclose doping said dielectric film such that the stoichiometry of said film is substantially uniform at least at said sidewall region." Since neither Azuma nor Hosotani recognize or solve the problem recognized and solved by the present invention, they do not render the claimed invention obvious. Accordingly, the rejection of claim 74 should be withdrawn.

Claims 75-83 depend from claim 74 and likewise contain the requirement that the stoichiometry of the BST high dielectric film material be double doped to produce a substantially uniform stoichiometry at least at the sidewall regions. Accordingly, the rejection of those claims should be withdrawn.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

Dated: February 11, 2002

Respectfully submitted,

By_____

Thomas J. D'Amico
Registration No.: 28,371
DICKSTEIN SHAPIRO MORIN &
OSHINSKY LLP
2101 L Street NW
Washington, DC 20037-s1526
(202) 785-9700

Attorneys for Applicant

Version With Markings to Show Changes Made

39. (Second Amended) A capacitor comprising:

a material layer having a first level and a second level, said first and second levels being connected by a sidewall region between said first and second levels; and

a[n ion implantation] doped BST high dielectric constant thin film material deposited on[formed] at least [on]one said sidewall region,[; the doping of] said deposited BST thin film material having a post deposition doping [being] such that the stoichiometry of said BST high dielectric thin film material is substantially uniform at least at said sidewall region.

48. (Second Amended) A capacitor comprising:

a material layer having a first level and a second level, said first and second levels being connected by a sidewall region between said first and second levels;

a[n ion implantation] doped BST high dielectric constant thin film material deposited on[formed] at least one said sidewall region,[; the doping of] said deposited BST thin film material having a post deposition doping [being] such that the stoichiometry of said BST high dielectric thin film material is substantially uniform at least at said sidewall region; and

a capping layer provided over at least a portion of said BST thin film material.

74. (Second Amended) An integrated circuit capacitor device comprising:

a material layer having a first level and a second level, wherein said first and second levels are connected by a sidewall region between said first and second levels;

a first electrode provided at least on said sidewall region;

a doped BST high dielectric constant thin film material provided on at least one said first electrode, [the doping of]said deposited BST high dielectric thin film material having [being] a post deposition doping such that the stoichiometry of said BST high dielectric thin film material is substantially uniform at least at said sidewall region; and

a second electrode provided on said BST high dielectric thin film layer.